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## USB4927/USB4925 Dual Upstream Operation

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### INTRODUCTION

The Microchip USB4927 and USB4925 smart hubs allow for smart-phone automotive mode sessions to be entered on the downstream ports via a Dual Upstream mode of operation (abbreviated as DUST).

The USB4927 supports the Dual Upstream operation on four downstream ports.

The USB4925 supports the Dual Upstream operation on two downstream ports.

The USB4927 and USB4925 hubs have two upstream connections. The primary upstream connection is used for general hub operation and is the only connection utilized when there is no active smart-phone automotive mode session. When an automotive session is initiated for a downstream port, that port is switched over to the secondary upstream port. The secondary upstream port is connected to an OTG capable port which operates in a device mode during the smart-phone automotive mode session. This allows the smart-phone to act as the USB host via the secondary upstream connection, while all other USB ports continue to operate as standard downstream ports with a connection maintained to the USB host on the primary upstream connection.

A Dual Upstream session may be entered on only one downstream port at a time. Entry into Dual Upstream mode is initiated via USB Control transfer addressed to the internal Hub Feature Controller device in the hub.

### SECTIONS

[Section 1.0, Functional Overview](#)

[Section 2.0, DUST Command Details](#)

[Section 3.0, Dual Upstream Mode Command Example](#)

### REFERENCES

Consult the following documents for details on the specific parts referred to in this document.

- *Microchip USB4925 Data Sheet*
- *Microchip USB4927 Data Sheet*
- *Microchip ANXXXX Configuration Options for the USB4715 and USB49xx*

## 1.0 FUNCTIONAL OVERVIEW

The internal block diagrams of Microchip USB4925 and USB4927 are shown below in [Figure 1](#) and [Figure 2](#) respectively.

Both USB4925 and USB4927 have an internal USB device called the Hub Feature Controller which enables the advance features of the hub. The Hub Feature Controller device is a standard WinUSB class device with Product ID 0x4940.

On the USB4925 the Hub Feature Controller is connected to port 4.

On the USB4927 the Hub Feature Controller is connected to port 6.

The hub port which is connected to Hub Feature Controller is configured as non-removable.

**FIGURE 1: USB4925 INTERNAL BLOCK DIAGRAM**

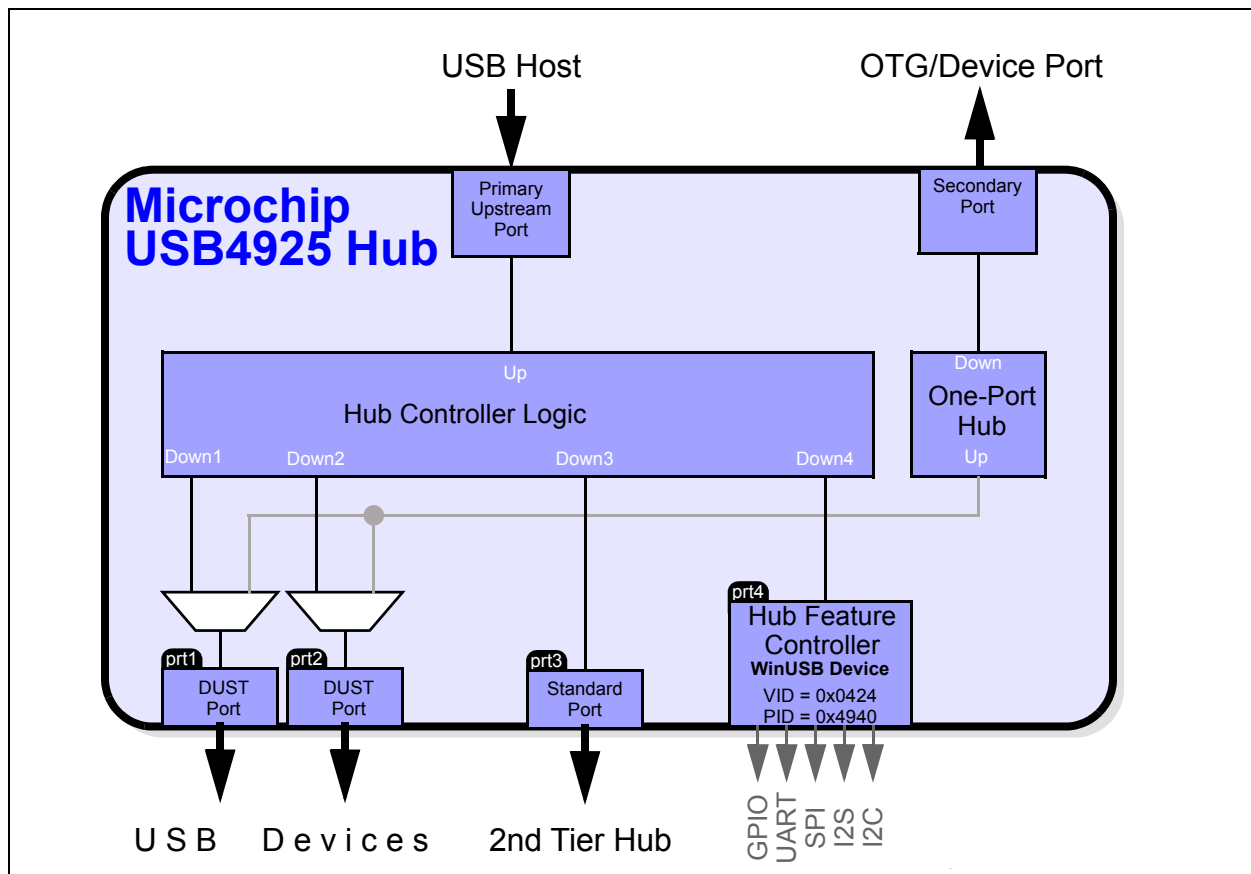
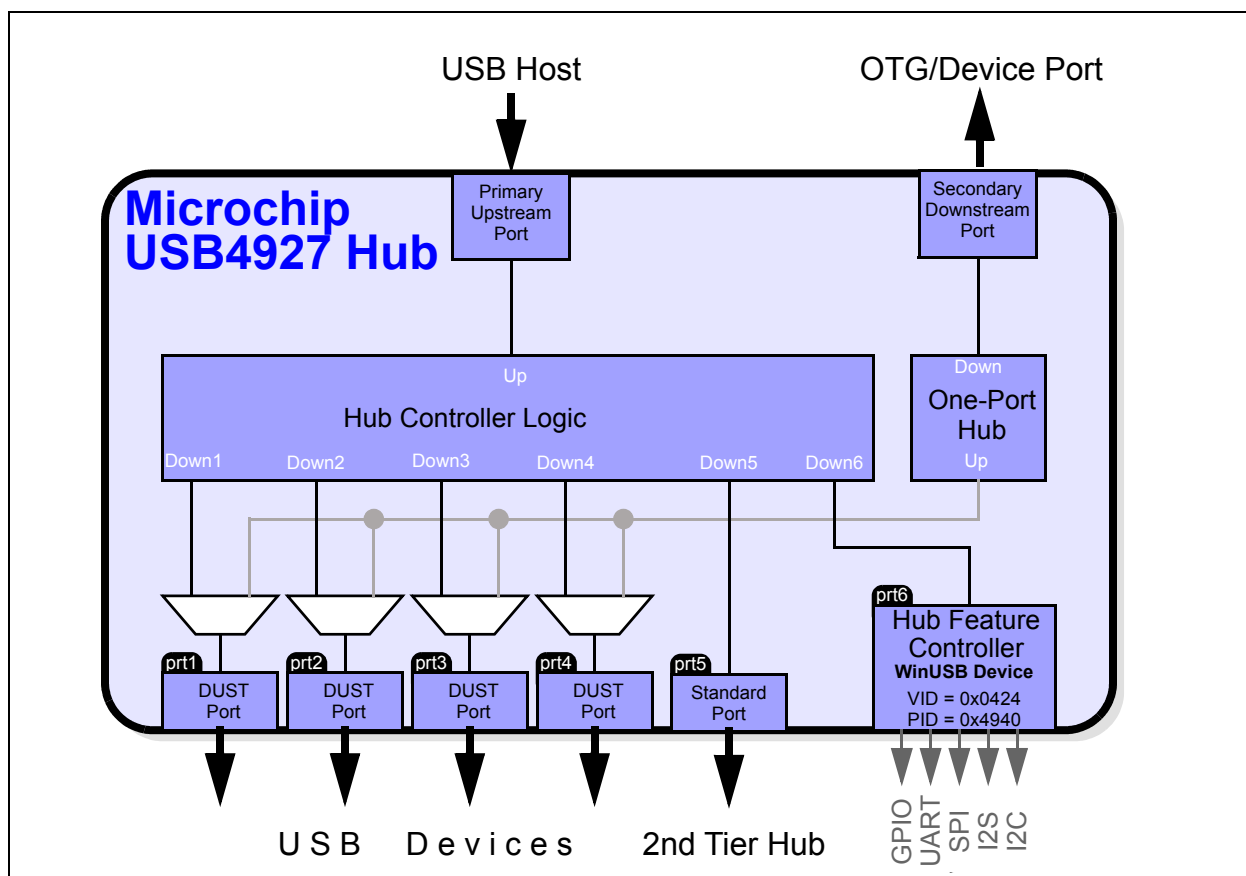


FIGURE 2: USB4927 INTERNAL BLOCK DIAGRAM



### 1.1 Dual Upstream Automotive Session

A DUST session is initiated via a USB command to the internal Hub Feature Controller device. The details of this USB command are shown in [Section 2.0, DUST Command Details](#), and an example USB protocol trace capture of the command is detailed in [Section 3.0, Dual Upstream Mode Command Example](#).

The USB4925 supports DUST operation on downstream ports one and two.

The USB4927 supports DUST operation on downstream ports one through four.

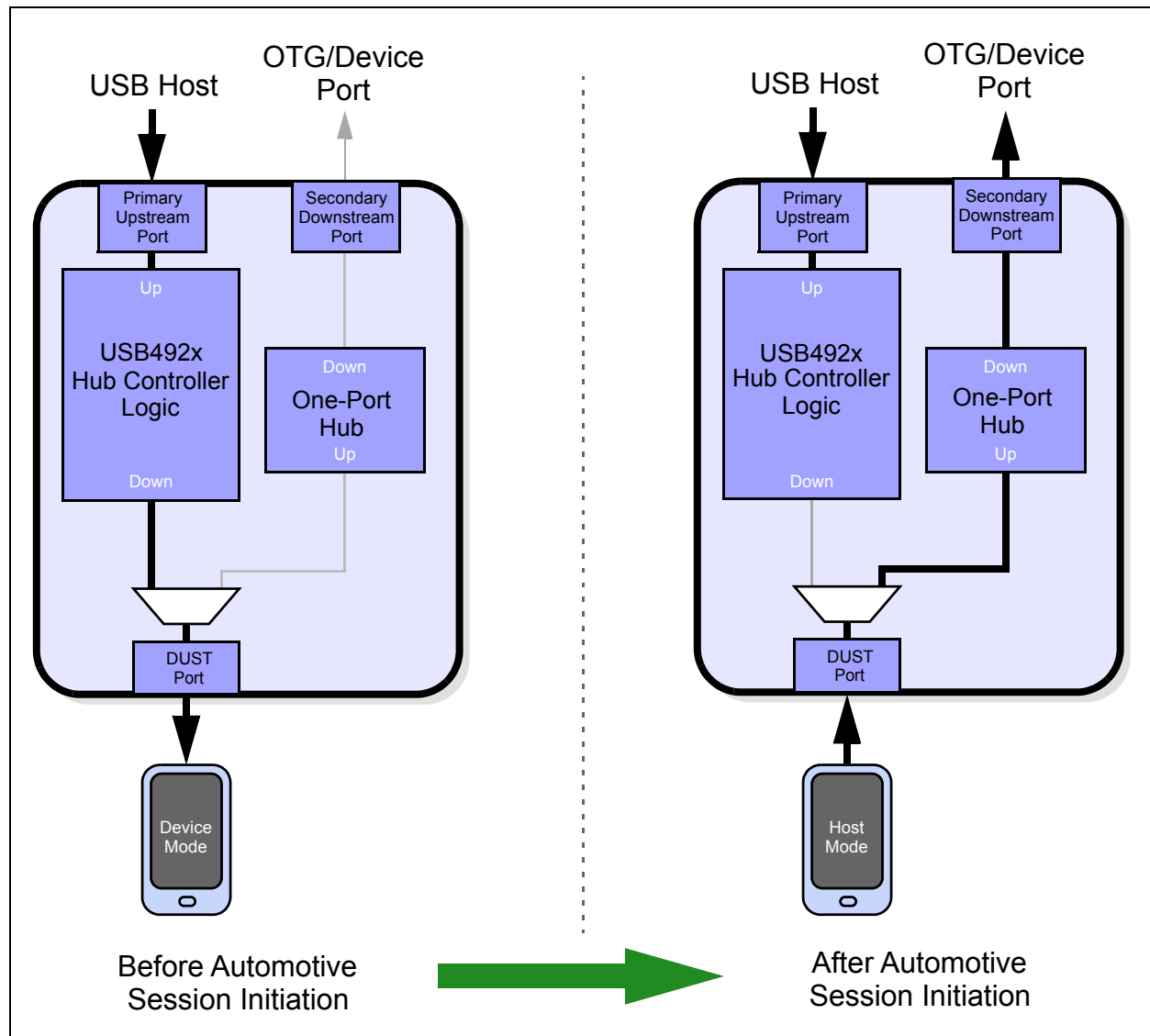
When a DUST session is initiated on one of the DUST capable downstream ports, the port is multiplexed over to a secondary one port hub device. This creates a dedicated connection between the smart-phone operating in automotive host mode and the automotive head unit.

A typical sequence of events for automotive session initialization is:

1. The automotive head unit (USB Host) enumerates a smart-phone on DUST capable port "X" and recognizes that it is capable of an automotive session.
2. The automotive head unit sends any necessary commands to the smart-phone in order to set that device into the automotive mode.
3. The automotive head unit sends the DUST command to the internal Hub Feature Controller device Endpoint 0 to switch port "X" into DUST mode.
4. The automotive head unit will see the smart-phone disconnect from port "X".
5. The smart-phone will switch to Host mode operation and will see a one-port hub attach.
6. The smart-phone will then detect the automotive head unit in device mode on the USB tier below the one-port hub.
7. Data can now be exchanged between the smart-phone operating in host mode and the automotive head unit's device mode port.

Figure 3 below shows the internal connections made both before and after an automotive session is initiated.

**FIGURE 3: DUAL UPSTREAM OPERATION**



## 2.0 DUST COMMAND DETAILS

The USB hub requires a specific USB command to be issued from the USB host to indicate when a DUST automotive session should begin.

The USB command is a NO DATA Control transfer which must be issued to Endpoint 0 of the internal Hub Feature Controller device. On USB4925, the Hub Feature Controller is the internal device located on Port 4. On USB4927, the Hub Feature Controller is the internal device located on Port 6. The SETUP command format is shown below.

**TABLE 1: DUAL UPSTREAM MODE SETUP PACKET**

Setup Parameter	Value	Description
bmRequestType	0x41	Device-to-host, vendor class, targeted to interface
bRequest	0x90	SET_ROLE_SWITCH
wValue	0xYYYY	Bits detailed below
wIndex	0x0000	Reserved
wLength	00	No data

**TABLE 2: WVALUE DETAIL OF DUAL UPSTREAM MODE SETUP PACKET**

Bit	Name	Description
15:11	Reserved	Reserved (Must Always Be '0')
10:8	ENUM_TIMEOUT	<p>These bits control a timer which is started when the DUST command is sent.</p> <p>If the smartphone does not enumerate the One-Port Hub before the timer expires, the hub will revert to the default state with wherein there is no active DUST mode automotive session.</p> <p>If the smartphone does enumerate the One-Port Hub, then the DUST mode automotive session will remain active.</p> <p>000 = No Timeout defined (hub will not automatically terminate Multi-Host Bridge automotive session)</p> <p>001 = 10 ms</p> <p>010 = 100 ms</p> <p>011 = 500 ms</p> <p>100 = 1 second</p> <p>101 = 5 seconds</p> <p>110 = 10 seconds</p> <p>111 = 20 seconds</p>
7	Reserved	Reserved (Must Always Be '0')
6:5	ROLE_SWITCH_TYPE	Must always '10' for DUST mode
4	ROLE_SWITCH_STATE	<p>1 = Transitions the port defined in PORT bits in to DUST session</p> <p>0 = Terminates DUST session currently active on port defined in PORT bits</p>

TABLE 2: WVALUE DETAIL OF DUAL UPSTREAM MODE SETUP PACKET (CONTINUED)

Bit	Name	Description
3:0	PORT	Physical downstream port to initiate or terminate Multi-Host Bridging session  0001 = Port 1 0010 = Port 2 0011 = Port 3 0100 = Port 4 All others = <i>Invalid</i>

### 3.0 DUAL UPSTREAM MODE COMMAND EXAMPLE

An example of the DUST session initialization command for Port 3 is shown below. This command is sent to EP0 of the Hub Feature Controller.

**TABLE 3: DUAL UPSTREAM MODE SETUP COMMAND EXAMPLE**

Setup Parameter	Value	Note
bmRequestType	0x41	Device-to-host, vendor class, targeted to interface
bRequest	0x90	SET_ROLE_SWITCH
wValue	0x0053	Bits 15:11 = 0000b Bits 10:8 = 000b (no enum timer) Bit 7 = 0b Bits 6:5 = 10b Bit 4 = 1b (Enter DUST session) Bits 3:0 = 0011b (Port 3)
wIndex	0x0000	Reserved
wLength	00	No data

**FIGURE 4: REGISTER READ SETUP TRANSACTION EXAMPLE**

Transaction	H	SETUP	ADDR	ENDP	T	D	TP	R	bRequest	wValue	wIndex	wLength	ACK	Time Stamp
32851	S	0xB4	3	0	0	H->D	V	I	0x90	0x0013	0x0000	0	0x4B	25 . 664 216 450
Packet	H	SETUP	ADDR	ENDP	CRC5	Pkt Len	Duration	Idle	Time Stamp					
207047	H	0xB4	3	0	0x0A	10	166.667 ns	233.330 ns	25 . 664 216 450					
Packet	H	DATA0	Data				CRC16	Pkt Len	Duration	Idle	Time Stamp			
207048	H	0xC3	41	90	53	00 00 00 00 00 00	0x1745	18	300.000 ns	266.000 ns	25 . 664 216 850			
Packet	D	ACK	Pkt Len	Duration	Time	Time Stamp								
207049	D	0x4B	6	100.000 ns	2.434 us	25 . 664 217 416								

## APPENDIX A: APPLICATION NOTE REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision Level & Date	Section/Figure/Entry	Correction
DS00002342A (01-18-17)	All	Initial release.



NOTES:

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